AN IDEA OF Arithmetick AT FIRST Designed for the use of the FREE-SCHOOLE AT *Thurlow* in *Suffolk*

By *R. B.* Schoolmaster there.

Heus, quid profeciſti in Geometria? de lineis & punctis ridicula quædam tenet. Quid in Arithmetica? dicit, ſe bene Numeraturum, ſi adſit pecunia. Quid in Aſtronomia? partem ſphæræ *Johannis à ſacro Buſco*, aliquando audivit adoleſcens in Scholâ. Quid in Muſica? Muſicam cantores ſcire aut in templo. Cedo quid de Perſpectivâ & Coſmographiâ? nec nomina audivit unquam, Curioſa (inquit) ſunt hæc & plena periculi; nefas eſt attingere.

Lud. Vives. l. 1. *de cauſis.*

LONDON,
Printed by *F. Fleſher*, and are to be ſold
[illegible] Bookſeller in *Cambridge*. 1655.

Ex dono Authoris

...Y. IDEA

OF

Arithmetick

AT FIRST

...igned for the use of the
FREE SCHOOLE

AT

Thorlow in Suffolk

By R. B. Schoolmaster there.

...qui proficisti in Oceanum? de lineis & punctis
...cula quadam teror. Quid in Arithmetica? dicis,
...hoc Numeraturum, & nihil pecunia. Quid in
...tronomia? parum lepora Sobrietà? Loca Parte,
...quando audivit adolescens in Schola? Quid in Ma-
...a? Multum camporum fere aut in templo. Cedo
...d de Perspectiva & Cosmographia? hoc omnia
...livit unguem, Curiosis (inquit) hunc bac & plena
...ficit, meras ait nugas etc.

Lud. Vives. l. 2. de corrupt.

LONDON,

...nted by R. Field, and are to be sold
...Bookseller in Cambridge. 1657.

TO

The Worſhipfull

and truly Honoured,

Sir *WILLIAM SOAMES*

KNIGHT;

R. B.

humbly dedicateth this

Treatiſe, for the furtherance

of his

Grandchild, that hopefull Branch,

WILLIAM SOAMES.

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The Principles.

1 ARithmetick is the Art of numbring.

2 An Unite is the beginning of number, according to which every thing is said to be one.

3 From the Collection of Unites ariseth multitude of Integers, from the partition of an Unite, parts or fractions, and they are *quasi numeri.*

4 All numbers are, or may be expressed with nine notes or figures, 1. 2. 3. 4. 5. 6. 7. 8. 9. necessarily significative, and the circle or cipher 0, which is insignificative before Integers and after Parts, serving onely to promote the valor of a figure by place or degree in Integers after Integers, to extenuate in Parts before Parts.

5 The place of a Figure is that seat it possesseth, whereby it assumeth a larger or lesser estimate according to its remotion from, or vicinity to the Unite place.

6 The Unite place seated immediately before the Rectangular separating line is the first, from which there ascendeth in the places an

orderly progression of Integers towards the left hand increasing *ad infinitum*, and descendeth in pares towards the right hand infinitely decreasing.

7 An integer is placed before the separating line (if there be any) a fraction after; a mixt number both before and after.

10	9	8	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
MM	M	MM	M	MM	C	X	I						X	C	M	M	M	M	M	M
MM	M	MM	C	X											X	C	M	M	M	M
MM	C	X															X	C	M	M
X																				X

8 The *notation*, or notation of Integers thus therefore, after each third place which makes a period, set a point from the unite place, then the figure after the first point shall be of M thousands χιλιάδων, the figure after the 2d M M *millies millium*, and so forth, the middle place X more ἑξάδων, the other C more ἑκατοντάδων: as in this Example which is the number of sands equal to the solid capacity of the whole earth at least, and is in the way to *Archimedes* his ψαμμίτης.

9m 8m 7m 6m 5m 4m 3m m , m

634'725'735'853'600'000'000'000'000'000

cx cx cx cx cx cx cx cx cx cx

or,

620'448'401'733'239'439'360'000 which is the number of combinations in 24 unites, which

or

or letters, the varieties whereof are so stupendiously many, that 10000 writers, singers and Compoſers could not ſet forth in 1000 years.

9 The notation of Fractions, which are, or ſuppoſed to be written or expreſſed in two numbers, one above the other thus $\frac{3}{4}$ the lower termed the Denominator equall to an unite or μονὰς, divided into ſo many parts, the upper the Numerator numbring how many parts muſt be taken of the lower. Now although any number may be the Denominator, yet here (thanks to the Inventor whoſoe he was) is a limitation aſſigned the Denominator in any operous Reſolution muſt be a Decimal Denominator taken from the Table before, not expreſſed but conſtantly underſtood, made up of an unite and cyphers ſo many annexed, as there be figures in the Numerator after the Rectangular line. This way ſaveth the pains of prolix reductions, intricate workings, is facile, naturall, and elegant. Imagine the laſt figure the unite place and pronounce them as Integers, as $\frac{75}{}$ that is ſeventy five hundred parts, or if you pleaſe, ſeaven tenths, five hundredths. So

$\frac{666666666666666666666666666}{}$

and a thouſand more fives is not a jot yet ſo precise that it wants ſeaned one of thoſe fends

nay 9 or 5 fractional places will insensibly suffice. So $\frac{3333333333333}{10000000000000}$ &c. is but $\frac{1}{3}$
Here note to supply the vacancy of the places in the Numerator with cyphers prefixed as 0000007.

10 Equal Fractions are those which are proportionall, namely when the Numerator of one is to its Denominator, as the Numerator of another to its Denominator.

11 Those Numbers are said to be proportionall or Analogicall, when the Ratio of the 1st to the 2d is equal to the Ratio betwixt the 3d and the 4th: which the Greeks term ἴσοντα & ταυτόπα τ λόγων, the Antecedents or Consequents being both greater or lesser; and this Ratio is found by dividing the Antecedent by the Consequent.

12 Any Number ἡγούμενο an Antecedent may be compared with any number a Consequent ἑπομένῳ, as 12 to 30: that comparison is either in respect of the difference, as 18, called the Arithmeticall habitude; or in respect of the Quotient, as $2\frac{1}{2}$: by which is known how often one contains or is contained of the other, and tis called the Geometricall habitude, or Ratio λόγος.

13 This Ratio is either of Equality, as 5 to 5; or Inequality, as 7 to 5: which is of the greater, or of the lesser, when the Antecedent

i. leaſt, as 5 to 7. Each of theſe either *multiplex*, when the Quotient is purely an Integer, as 42 to 7. *ſextupla*; 10 to 1 *decupla*; *ſuperparticularis*, when the Quotient is 1 and one Aliquot part beſides, as 7 to 6: $1\frac{1}{6}$ cald *ſeſquiſexta*, and here the difference is an Unite; *ſuperpartiens* when the Quotient is 1 and ſome more parts beſides, as 9 to 5. tis $1\frac{4}{5}$ namely *quadrupartiens quintas*: *multiplex ſuperparticularis*, when the Quotient is above 1 and ſome one part beſides, as 15 to 2 is *ſeptupla ſeſquialtera*: *multiplex ſuperpartiens*, when the Quotient is above 1 and ſome more parts beſides, as 17 to 5 is *tripla ſuperbipartiens quintas*, when tis of the leſſer *ratio* prefix *ſub*, as 2 to 15 *ſubſeptupla ſeſquialtera*.

14 If betwixt ſufficient terms the *Ratios* are equal, the Proportion is Geometrical: if the differences, Arithmetical: if betwixt any of the terms immediate and al; tis continued: if onely betwixt 1ª and 2ª, the 3ª and 4th. tis diſcontinued.

		3	3	3	3	
Geom:	1	3	9	27	81	*contin: its ſign* ∴
		4	12	18	54	*diſcont: its ſign* ∴
Arith.	3	6	9	12	15	*contin: its ſign* —
		4	7	18	21	*diſcon: its ſign* ∴

15 Becauſe

15 Because the Arithmetical faculty consisteth in the Adding, Substracting, Multiplying, Dividing, Extracting of Roots and the dextrous application of the same in the performance of any question; consider them under the notion of 5 operations.

16 Addition then is of severall numbers given to find ὅλον συναγόμενον the entire summe, which new found number is equal to all the Parts; whose sign + is the sign of affirmation in simple. pl. in compound and simple quantities, and that quantity that beginneth with no sign before it supposeth it.

17 Subtraction taketh one quantity out of another to find the remainder, which is διαφορὰ the difference, the sign of Subduction as also of negation let —— be in simple; mi. in compound and simple quantities.

18 Multiplication to two numbers called Factors *intera*, πολλαπλασιάζοντες Multiplyers, findeth the γενόμενον fact Rectangle or plane in such a *Ratio* to one Factor, . . . 6 . . . as the other to an Unite . . . 24 . . . namely 24 . 6 . . 4 . 1 or 4 . . . 24 . . . 1 . 6 . . 4 . 24 . its sign × or commonly none betwixt the quantities.

19 Division searcheth out the Quotient in such a *ratio* to 1 as the Dividend to the Divisor,

visor) these 3 Numbers *Euclid* cals μετρῦντα, μετρούμενον & μέτρον as 1 6 4 :: 24 : 6
hence note an unite either Factor or Divisor alters not the other.

1 · 6 :: 1 · 6 Dividend above its sign is a long line betwixt the ——— Divisor beneath

20 Extraction of Roots is the investigation of such a side or Root of a number, which multiplyed into it self according to the power of the number, so often that it produce the number it self: so 12 is the square Root of 144 the 2d *potestas* for 12 · 12 is equall (thus marked =) to 144: again 57 the Cubick Root of 185193 for 57 · 57 · 57 = 185193 the 3d *potestas &c.* √ is the sign of a simple *potestas*, and if the *potestas* be included on both sides it denotes its universall Root. q represents a *quadrate*, the 2d power namely. Aq = AA. c a Cube the 3d *potestas*: *viz.* Ac = AAA: qq *a quadratoquadrate* the 4th power *viz.* AAAA = Aqq.

21 Any quantity may be designed by any Species v c g by A.

22 The Catholick Theorem if A represent the Antecedent, C the Consequent, and it be A : C :: a · c and the *Ratio* be R that Ac = Ca : for because A = CR and a = cR · the terms are the same thus, CR :

C :: cR : c . therefore CRc = CcR namely the fact of the extremes = to the fact of the means in any 4 terms *Geom.* :: *ἐναλλὰξ λεῖξαι.*

23 If A : C :: a · c then alternately A : a :: C : c otherwiſe Ac were not = aC as is proved by the former ; alſo inverſedly C : A :: c : a by the ſame argument.

24 In A · C · · a · c Arithmetically proportionall A + c the ſumme of the extremes = C + a ſumme of the means, if D be the difference it will be D + C = AC D + c = a the terms are the ſame thus D + C · C · · D + c · C therefore D + C + c = C + D + c.

25 In the former Table the upper numbers are Indices in ∴ of the terms or places below ; *affirmative* of Integers, *negative* of Parts ; a cypher being put the *Index* of the *monad* or unite place the Ratio of the terms below in ∴ *decuple* from the left toward the right hand, *ſubdecuple* from the right toward the left hand : the negative *index* is diſcerned by a line *ſuperimpoſed*, as $\bar{3}$ if the *indices* be 3 , 1 or $\bar{3}$ $\bar{1}$ they are *homogeneal* if 3 , $\bar{1}$ or $\bar{3}$, 1 *heterogeneal* in adding and ſubſtracting.

26 The converſion of Fractions, whoſe Denominator is not *decimal*, to a *decimal* Fraction, a prevenient work ; as the *nondecimal* Denominator to the *nondecimal* Numer:

ſo a ſufficient *decimal* Denominator to its Numerator to be diſpoſed after the *Separatrix* and Cyphers prefixed, if any void places. Thus

17
—— 20 : 17 : : 1 with Cyphers, to |85
20

that is, divide the Numer: by the Denominator the Quotient is the Anſwer, again the converſion of *decimal* Fractions to ordinary Fractions a Subſequent work as 1 with Cyphers: to its Numer: |85 : : ſo uſuall Denominator 20 to 17, that is, multiply *decimal* Numer: by the ordinary Denominator for the more famous Numerator.

By which you may compoſe theſe or other Tables, according to your occaſions, in the firſt the pound is the unite, uſed when the queſtion is given in pounds, in the 2[d] the ſhilling is the unite, when given in ſhillings, the 3[d] pound *Troy* is the unite; the 4[th] pound *Averdupois*, the laſt of any unite divided into halfs, quarters &c.

ſhillings:

Place here the TABLE.

shillings.

19 = 95
18 = 9
17 = 85
16 = 8
15 = 75
14 = 7
13 = 65
12 = 6
11 = 55
10 = 5
9 = 45
8 = 4
7 = 35
6 = 3
5 = 25
4 = 2
3 = 15
2 = 1
1 = 5

11 = 045833
3 = 9791
2 = 9582
1 = 9374
11 = 91666
3 = 8958
2 = 8749
1 = 8541
10 = 83333
3 = 8225
2 = 7916
1 = 7708
9 = 75
3 = 7291
2 = 7082
1 = 6874
8 = 66666
3 = 6458
2 = 6249
1 = 6041
= 5833

ounces.

11 = 91667
10 = 83333
9 = 75
8 = 66666
7 = 58333
6 = 5
5 = 41666
4 = 33333
3 = 25
2 = 16666
1 = 08333

19 = 07916
18 = 075
17 = 07083
16 = 06666
15 = 0625
14 = 05833
13 = 05416
12 = 05
11 = 04583

ounces.

15 = 9375
14 = 875
13 = 8125
12 = 75
11 = 6875
10 = 625
9 = 5625
8 = 5
7 = 4375
6 = 375
5 = 3125
4 = 25
3 = 1875
2 = 125
1 = 0625

15 = 058594
14 = 054688
13 = 050781
12 = 046875
11 = 042969

pence.

9 = 0375
8 = 033333
7 = 029166
6 = 025
5 = 020833
4 = 016666
3 = 0125
2 = 008333
1 = 004166

farth.

3 = 003125
2 = 002083
1 = 001041

2 = 5416
1 = 5208
6 = 5
3 = 4791
2 = 4582
1 = 4374
5 = 41666
3 = 3958
2 = 375
1 = 3541
4 = 33333
3 = 3124
2 = 2916
1 = 2708
3 = 25
3 = 2292
2 = 2083
1 = 1875
2 = 16666
3 = 1458
2 = 1249
1 = 1041
1 = 0833
3 = 0625
2 = 0416

penny w

9 = 0375
8 = 03333
7 = 02916
6 = 025
5 = 02083
4 = 01666
3 = 0125
2 = 00833
1 = 00416

grains.

23 = 00399
22 = 00381
21 = 00364
20 = 00347
19 = 00329
18 = 00312
17 = 00295
16 = 00277
15 = 00266
14 = 00243
13 = 00225
12 = 00208
11 = 00191
10 = 00173
9 = 00156
8 = 00138

drachmes.

9 = 035156
8 = 03125
7 = 027344
6 = 023438
5 = 019531
4 = 015625
3 = 011719
2 = 007812
1 = 003906

quarters.

3 = 002929
2 = 001953
1 = 000765

¼ = 175
½ = 15
¼ = 25
¼ e ¼ = 1875
½ e ¼ = 125
¼ ¼ = 0625
¼ e ¼ e ¼ = 046875
½ e ¼ e ¼ = 03125

1 = .1875		15 = .00266	$\frac{1}{4}$ = .75
2 = .16666		14 = .00243	$\frac{2}{2}$ = .5
3 = .1458		13 = .00225	$\frac{3}{4}$ = .25
2 = .1249		12 = .00208	$\frac{1}{4}\frac{1}{4}$ = .1875
1 = .1041		11 = .00191	$\frac{1}{2}\frac{1}{4}$ = .125
1 = .0833		10 = .00173	$\frac{1}{4}\frac{1}{4}$ = .0625
3 = .0625		9 = .00156	$\frac{1}{4}\frac{1}{4}\frac{1}{4}$ = .046875
2 = .0416		8 = .00138	$\frac{1}{2}\frac{1}{4}\frac{1}{4}$ = .03125
1 = .0208	grains.	7 = .00121	$\frac{1}{4}\frac{1}{4}\frac{1}{4}$ = .015625
		6 = .00104	
		5 = .00086	
		4 = .00069	
		3 = .00052	
		2 = .00034	
		1 = .00017	

The Operations.

Addition Πρόσθεσις.

AFter the numbers to be added are disposed in their proper places κατὰ τάξιν, beginning at the right hand note down under the true places the particular summe of each degree κατὰ τάξιν, in the book of *Notes*. cap. 1.

cxmcxi	46500 *Reuben*
3 4 5 6 7 8 3	59300 *Simeon*
4 3 8 5 severals	45650 *Gad*
7 8 4 5 given	74600 *Judah*
5 6 7	54400 *Issachar*
	57400 *Zebulon*
4 5 8 9 2 5 summe sought	40500 *Joseph*
	32200 *Manasses*
	35400 *Benjamin*
	62700 *Dan*
	41500 *Asher*
	53400 *Naphtali*

the Aggregate Subtraction.

A

l.	s.	d.	
48	12	10 ob.	48 | 6437503
37	13	9 ob.	37 | 6895833
24	16	07	24 | 8291666
10	10	10 ob.	10 | 5437503
121	14	1 ob.	the collect sum. 121 | 7062505

The best probation δοκιμασία, is by a double working downward and upward; abjection of nines being fallible, and multiplicity of Subtractions tedious.

In Specious quantities connexion of the Symbols keeping the signes is Addition.

In Indices

ad	2b	2b	b	a	2b + aaq + 5a
adde	3b	- b	- 2b	b	3b - aaq + a
Sum.	2b + 3b	2b - bb	- 2b	4b	5b 2aq - 4a
	=	=	=		
	5b	1b	- 1b		

or logarithms

Subduction ὑφαίρεσις.

After the disposition of the numbers as before, beginning at the right hand, note down in the true places the particular differences of the notes in each degree, the subtrahend

taken from the *numerator è quo*: wherein if a figure be leſſer then its coordinate in the other, ſuppoſe 1 added to that leſſer figure taken from the next ſuperior place, which muſt be compenſated either by the augmentation of 1 in the inferior, or diminution of 1 in the ſuperior.

672	*Numerus è quo*	} *dati*	5604 *An. mundi*
451	*ſubtrahendus*		1655 *An. Chriſt.*
221	*differentia quæſit.*		3949

l.	s.	d.		48|641666	678135
48	12	10	or	19|370833	214673
19	07	05			
29	05	05		29|270833	463462

The proof is made by adding the difference and the ſubtrahend to be equal to the *Numerus è quo.*

Specious Subduction is the connexion of the ſymbols given; the ſign of the ſubducends affection changed into the contrary.

					In Indices.
Ex	5a	3a	7a	3c	2a+b 2aq ab
tolle	2a	7a	-3a	-4d	a-b aq. 2ab
Reſt.	5a-2a	3a-7a	7a+3a	3c+4d	a+2b aq+ab
hoc eſt	3a	-4a	10a		

4	4	3	4	3	
3	3	4	3	4	
1	1	1	1	7	7

in logarithms.

No Addition or Subduction of parts can be, till they be reduced to the ſame denomination; which is by dividing the denominators by their greateſt common diviſor, and multiplying the

terms by the alternate quotients, then ſuffix the common denominator under the ſum for Addition, the difference for Subſtraction.

$$\begin{array}{l} ae \pm bg \\ \overline{a \pm b} \\ d)\overline{dg\ de} \\ \quad g\ \ e \\ \quad \smile \\ \quad dge \end{array} \text{ becauſe } \left.\begin{matrix} dg : a \\ de : b \end{matrix}\right\} :: \left\{ dge : \left\{\begin{matrix} ae \\ bg \end{matrix}\right.\right.$$

Multiplication Πολλαπλασιασις.

TO order the Factors a right place that factor above that hath moſt ſignificant figures and biggeſt, place the other under ſo, that the moſt right hand figures anſwer perpendicularly, and multiply all the notes of one factor into all the notes of the other factor, writing underneath the particular facts in their due places, and at laſt adde them for the entire fact required, cutting off ſo many places of parts in the fact, as there are in the factors: if there be any ciphers at the end of the factors, exclude them out by a perpendicular line, and receive them again in the fact. To the exact underſtanding of the places; addition of indices is requiſite. *Pythagoras* his table is preſuppoſed perfectly imprinted in the memory, as a e i o u can be.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

76543210 *indices*

4567 } *factors*
84 }

18268 *partial facts*
36536
383628 *entire fact*

the *indices* 3+1=4 declares that 4+8=32 the right hand figure 2 will be under 4 the *index* that there will be 6 places.

ca. v.

300 × 50 × 30 *Gen.*6.15. 450000 cubical cubits the solid capacity of *Noahs* Ark.

5 | 0
3 | 00
15 | 000
3 | 0
45 0000

365
130
1095
365
47450

130 × 365 1 *K.*4.c.22.v. 47450 the number of Sheep and Oxen *Solomon* spent in one yeer.

60 × 20 × 30 36000. *Solomons* Temple much exceeded by *Noahs* Ark in the solid content.

Multiplication in ſpecies connecteth the factors with the ſign × or without any at all if they be ſimple: ſo that if the ſignes be homogeneal the fact ſhall be adfirmative, if heterogeneal negative.

duc.	B	b+o	b-o	B+F+K	6e	D+1
in	O	a	a	Y	3e	E
fiet	BO	ba+ao	ba-ao	BY+FY+KY	18eq	DE+1E

duc.	BC	A E	A+E	A—B
in	B	A E	A+ E	D—G
fiet	Bq C	Aq Eq	Aq+AE +AE+Eq	DA-DB-GA+BG

Aq+2AE+Eq *quadrati Geneſis in Binomiis.*
A+E

Ac+2AqE+AEq
AqE+2AEq+Ec

Ac+3Aq E+3 A Eq + Ec *cubi Geneſis &c.* and ſo continuing, multiplying by the binomial ſide; the reſt of the ſcalary quantities or Poteſtates are begotten according to the Table beneath.

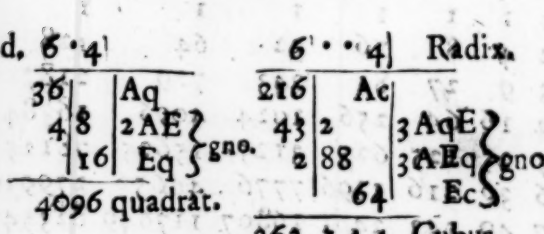
The reaſon why -B x -G = + B G is becauſe A x -G = -AG is leſs then juſt, and ſo -D B. For that it is too much by B. and D, too much by G. wherefore in compenſation to -D B-G A which deny too much. BG, is affirmed.

1	2	3	4	5	6	7
l	q	c	qq	qc	cc	qqc
1	1	1	1	1	1	1
2	4	8	16	32	64	128
3	9	27	81	243	729	2187
4	16	64	256	1024	4096	16384
5	25	125	625	3125	15625	78125
6	36	216	1296	7776	46656	279936
7	49	343	2401	16807	117649	823543
8	64	512	4096	32768	262144	2097152
9	81	729	6561	59049	531441	4782969
A	Aq	Ac	Aqq	Aqc	Acc	Aqqc

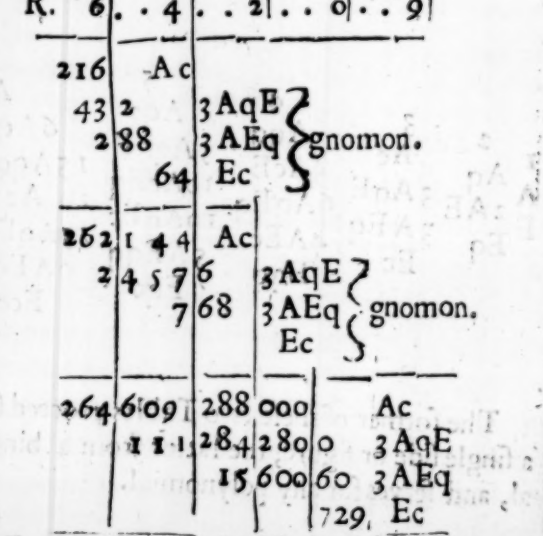
1	2	3	4	5	6
					Acc
				Aqc	6AqcE
		Ac	Aqq	5AqqE	15AqqEq
A	Aq	3AqE	4AcE	10AcEq	20 Ac Ec
E	2AE	3AEq	6AqEq	10AqEc	15AqEqq
	Eq	Ec	4AEc	5AEqq	6AEqc
			Eqq	Eqc	Ecc

The former of these two Tables proceed from a single side or figure, the latter from a binomial, and serves for any polynomial.

Explication in Numbers.



So also from the Root 57209 ariseth 1071167594880904176 1 qq.



Division

Diviſion Διαίρεσις.

BEgin at the left hand and after a ſufficient particular dividend, that is not leſſe then the Diviſor, is found, and ſuppoſing all the Diviſor to be under written; take all the figures of the Diviſor out of all the figures of the Dividend equally and as oft as can be, then the Diviſor multiplyed into the quotient laſt found and the fact ſubducted out of that particular Dividend, remove the Diviſor into the following places till the whole Dividend, making uſe of Cyphers ſet after for the fraction part, be wrought through: Cutting off ſo many places from the right hand of the Dividend, as there are Cyphers in the Diviſor.

Dividend	22	
6	2144	3210
diviſor 8) 144 (18 quotient	27) 183303	(6789
84	162963	
6	20814	
Subduction of indices exhibit the true place of the Quotient, *viz.* 4 — 1 = 3	22	
	183303	

xx 1
x28574 73
727573 634
4693711 6419
1987) 24567839|0000(12364|2873
19874128 4691
12364|2873 + 3976247 906
and 7 — 3 = 4 5999899
which indicates 1173535
5 places Integr. 11
24567839

If the Diviſor be irrational or infinite ſuch as this 174|306724587 + take as many figures as are fit and leſſen the diviſion every time after by a place.

Becauſe $\frac{B \times b}{b}$ or $\frac{B}{b} \times \frac{b}{1} = b$ hence the proof of Multiplication by Diviſion and *vice verſa* is manifeſt but both too operous, the former may eaſier be tryed by ſubſtracting of the ſeverall facts from the totall fact, as here Diviſion by adding the facts.

Diviſion in Symbols ſets the Dividend over the Diviſor with —— between them the ſame ſignes give + unlike —

Ad-

Adplica	BO	ba-ao	DE+1	EBqC	AqEq
ad	B	a	E	BC	AE
hoc eſt	O	b--o	D+1	B	AE

In parts compare (or reduce) unlike terms, and multiply like for multiplication: compare like and multiply unlike for diviſion reſolving the integers which occur into parts fraction-wiſe.

$$\frac{C}{D}\ \text{in}\ \frac{D}{1} = C \left| \frac{C}{D}\ \text{in}\ \frac{K}{1} = \frac{CK}{D} \right| \frac{B}{A}\ \text{in}\ \frac{RB}{D} = \frac{RBq}{AD}$$

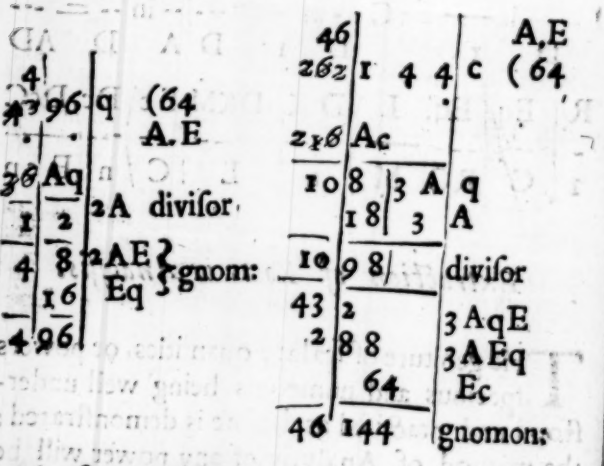
$$\frac{R}{1} \left| \frac{Eq}{C} \right| \frac{Eq}{RC} \left| \frac{L}{M} \right| \frac{DK}{1} \left| \frac{DKM}{L} \right| \frac{Ec}{C} \left| \frac{Dc}{n} \right| \frac{DcC}{Ecn}$$

Extraction of Roots or Analyſis.

THe geniture of ſcalary quantities, or powers ſpecious and numerous being well underſtood and practiſed as before is demonſtrated: the method of Analyſis of any power will be obvious from this general precept illuſtrated by a type or two. Having made diſtinguiſhing punctations from the unite place, intermitting 1 place for q: 2 for a c. &c. according to the interpoſition of complements, take the diagonal

Poteſtas

Poteſtas from the figures of the firſt point on the left hand, and put A its ſide in the root place, then divide the number to the next point which includes the gnomon by the diviſor rightly made up for E by which complete the gnomon, and ſubduct from the reſidue: next imagine thoſe two figures in the root place A, proceed for the diſcovery of E and ſo forward, repeating the work adding ciphers convenient when the number empowred is not truly figurate for the fraction part.



by the ſame artifice
the diſcovery of 364720587881329 :
c will be (64209
and of 107116759488090417 61 :
qq will be (57209

ſo

ſo √q 144 = 12 the Churches number: √q 666 = 25|80697580112 + = the number of the beaſt 13 Apoc. ult. ὁ ἔχων τὸν νοῦν ψηφισάτω τὸν ἀριθμὸν τοῦ θηρίου, as Mr. *Potter* in his accurate tract upon that ſubject: let the new lighted pretender expreſſe the ſide of 12000 the ſetled Cube of the new *Jeruſalem*, Apoc. laſt.

Concluſions.

THE wonderfull variety of queſtions (in the ſolution whereof the office of Arithmetick doth in truth conſiſt) eſpecially ſuch as in practice and ſecular dealings do occur (if we will not be unjuſt in wronging and deceiving others or our ſelves, dealing, that an honeſt Ethnick hates) are almoſt reducible to theſe Claſſes.

1. Such queſtions, wherein 3 Numbers, two implying a Ratio, the 3ᵈ interogatory, to which the firſt is homogeneal; are given; belong either to the *Golden Rule Direct*, when more will have more, or leſſe leſſe, an infallible κριτήριον: if 46 ells ſold 86 *s.* tell me the price of 9 ells. Or to the *Golden Rule Reciprocall*; where more will have leſſe, or leſſe more: as if a Magazine of victualls ſerve 1006 Souldiers

360 day's, how many will the ſame ſerve 120 days?

2. Queſtions, wherein 5 terms are given, 3 or 4 Anticedents being conditionall to 2 or 1 conſequent being interrogatory: as if 46 yards of Drapery $\frac{1}{4}$ broad, coſt 19*l.* 14*s.* 3*d.* how much ſhall 53 yards of like ſtuffe, that is $\frac{3}{4}$ and $\frac{1}{4}$ of $\frac{1}{4}$ wide, an example to the firſt of the 2^{d} ſort. If 2 Philipps Dollars equall 9*s.* and 15*s.* equall + 2 Duccats, how many Dollars equall to 100 Duccats, belong to the *Double Golden Rule.*

3. Queſtions, wherein many Partners *A E I O* unite their adventures; ſuppoſe *A* 806*l.* *E* 556, *I* 428, *O* 305. ſuppoſe for unequall intervals of times *A* 16 months, *E* 12^{m}, *I* 9^{m}, *O* 8^{m}, and thereby to find the particular loſſe or gain belonging to each, if onely the former are the διδόμενα, are reſolved by the *Rule of Society*: if the latter or ſuch like whereby the Queſtion is more complicated, by the commonly called *Rule of Fellowſhip with Time.*

4. Queſtions, wherein many things as *A, B, C, D, E* as Tobaccoes of ſeveral rates, *A* 15*s.* the pound, *B* 12*s.* the pound, *C* 10*s.* *D* 8*s.* *E* 7*s.* are given to be commixed at ſome mean rate, the ζητούμενα are what quantity to be taken of each: or beſides, the quantity of one ſuppoſe *E* 19 pound is given; to know the quantity of the reſt; or the quantity of the

whole

whole mixture limited, ſuppoſe 85 pounds are to be reſolved by *Alligation alternate:* or laſtly the prices of each, and quantities of each *A* 49 pound, *B* 40 pound, *C* 30 pound, *D* 25 pound, *E* 20 poũd, to ſearch what any quantity of the compound is worth reduced to *Alligation Mediall.*

5. Queſtions, wherein there is Diſtribution of numbers according to ſeverall Ratioes deſigned in parts, ſuch as this, *G* left his children *A*, *B*, *C*, *D* at his deceaſe 5674 *l.* thus to be exhibited

A ſhall have $\frac{6}{1}$ to *B*. *B* ſhall have $\frac{4}{1}$ to *C*. *C* ſhall have $\frac{2}{1}$ to *D*.

What is each childs part to be known by *Poſition ſingle?* Or the queſtion is about partition of numbers according to ſeveral Ratioes or differences or both not reſolvable by that; as if *G* bequeathed 8460 *l.* to *A*, *B*, *C*, *D*, *E*, that *A* ſhall have 1008 pound more then *B*, & *B* 290 *l.* more then *C*, & *D* to have $\frac{1}{4}$ of *A*, & *E* $\frac{1}{4}$ of *B*: is anſwered by *Poſition Double.*

6. The ſolution of this laſt ſort and others more intricate, as if *A*, *E*, *I* ſhould, reaſon in this manner, if I had 480 *l.* more then I have ſaith *A*, I ſhould have as much as both you, ſaith *E* 480 *l.* added to mine were equall to twice as much as both you have; *I* ſaith if I had 480 *l.* added to mine I ſhould have thrice as much as both you, how much had each? Or if it were required to find a number increaſed by 8 drawn into the ſame decreaſed by 8

ſhould

ſhould be 6497 ſuch, as theſe are to be referred to the rule of *Æquation.*

7. Queſtions of compounded Intereſt or Anatocism, as 1° what is the amount of 56 *l.* in 5 years at the rate of $\frac{6}{100}$ to 1 in 1 year or 2° an Annuity of 19 *l.* detained 11 years after the former rate, what will be the amount thereof? or 3° an Annuity of 15 *l.* to endure 6 years after the ſame rate, how much is it worth in ready money? The Performance whereof is proper to *Geometrical Proportion continued.*

8. Queſtions wherein are terms ſuppoſed to proceed after equality of differences, as if *A* travailed 540 miles in 9 dayes, increaſing his journey each day by 5 miles, how many miles went he the firſt, how many the laſt day? belong to Arithmetical proportion continued.

Golden Rule Direct.

$$A : B :: \alpha : \beta$$

the Rule $\frac{B\alpha}{A} = \beta$ and in $B : A :: \beta \alpha$ $\frac{A\beta}{B} = \alpha$ and in $\beta : \alpha :: B . A$ for $\frac{B\alpha}{\beta} = A$ and $\alpha : \beta :: A . B .$ for $\frac{\beta A}{\alpha} = B$ or this to $\frac{A}{B}$ the Ratio adply $\frac{\alpha}{1}$ in the firſt Analogy.

Golden

Golden Rule Reciprocal.

$A : B :: \alpha : \beta$

the Rule $\frac{AB}{\alpha} = \beta$

Double Golden Rule.

The posiure of the terms, first the main cause A, secondly the circumstance B, next the third C in the hypothetical part, in the consequential part, place them homogeneally.

A . B . C

a . β .

either by two analogies A. C :: a . $\frac{C\alpha}{B}$ and B . Ca :: b . $\frac{Cab}{A}$

$\frac{1}{A} : \frac{1}{BA} :: \frac{C}{Ca} : \gamma$ which is the Rule, if the third place be void, but if thus A . B . C.

a . γ.

A . B :: a — $\frac{AB}{a}$ and if $\frac{CAB}{1\alpha} : \frac{\gamma.AB\gamma}{Ca}$ the Rule.

by

by the ſame Ratiocination if they were thus diſpoſited A. B. C. as B A :: b. BA. and C.

$$\frac{\text{b. } \gamma}{\beta} \quad \frac{\text{BA}}{\iota} :: \frac{\gamma}{\text{BA}\gamma} \text{ to } \frac{\text{b}}{\text{c}\beta} \quad \frac{\text{BA}}{\text{I}} \text{ the Rule.}$$

when there are 4 conditional terms if $\alpha = \beta$ and $\gamma = \delta$ to how many Ang: are ε equal to

Ang: ſh: dol. Ang. ſh: dol.

$$\delta : \gamma :: \varepsilon . \frac{\gamma\varepsilon}{\delta} \text{ and } \beta : \alpha :: \frac{\gamma\varepsilon}{\delta} \frac{\gamma\varepsilon\alpha}{\beta\delta} = \zeta$$

or $\frac{\beta\delta\zeta}{\gamma\alpha} = \varepsilon$

Rule of Fellowſhip.

A, B, C, D, E are the particulars $\text{O} = \text{A}+\text{B}+\text{C}+\text{D}+\text{E}$: and N the gain or loſs.

$$\text{O} : \text{N} :: \begin{cases} \text{A} \\ \text{B} \\ \text{C} \\ \text{D} \\ \text{E} \end{cases} \text{ to their reſpective partial gain or loſſe}$$

If with time, then α, β, γ, δ, ε the ſeveral

veral times and $O = A\times\alpha + B\times\beta + C\gamma + D\delta + E$.

$$O : N :: \begin{cases} A\alpha \\ B\beta \\ C\gamma \\ D\delta \\ E \end{cases}$$ to each mans gain or loſſe

Alligation.

ALternate; let A, B, C, D, E ſeveral prices, M the mean price, diſpoſe the prices perpendicularly, and M betwixt its next extremes, linking each greater with a leſſer; alternately ſetting down the difference betwixt the mean price and each of the reſt.

E−M pl D−M = κ
C−M = λ the
M−B = μ ſeveral
M−A = ν quantities.
M−A = ν

Therefore $\kappa + \lambda + \mu + 2\nu$ = to the whole mixture z, becauſe $zM = A\kappa + B\lambda + C\mu + D\nu + E\nu$.

Again suppose of A, α stated measure were fixed O, then say

$$x : o :: \begin{matrix} \lambda \\ \mu \\ \nu \\ \gamma \end{matrix}$$ To each new quantity in that proportion,

Again suppose the whole composition ω were assigned, alter the proportions thus.

$$z : \omega :: \begin{matrix} x \\ \lambda \\ \mu \\ \nu \\ \gamma \end{matrix}$$ to the new quantities to make up ω.

Lastly in mediall let A, B, C, be the quantities given α, β, γ the prices of one quantity of each, then

$A+B+C : A\alpha+B\beta, C\gamma :: 1 : \frac{}{}$ to the price of one quantity of the mixture.

Position.

D divided into 5 parts required, so that A shall be *quintuple* to E, E *quadruple* to I, I *triple* to O, O *duple* to U.

Let α be for U then $2\alpha = Q : 6\alpha = I : 24\alpha = E$ $120\alpha = A$ and say

$$\alpha + 2\alpha + 6\alpha + 24\alpha + 120\alpha : D :: \begin{matrix} \alpha \\ 2\alpha \\ 6\alpha \\ 24\alpha \\ 120\alpha \end{matrix}$$ to the parts responsible to D.

In

In double position twice make supposition, mark the errors with exced. or defic. multiply the errors by their alternate positions; if the errors be homogeneal, divide the difference of the products by the difference of the errors, but if heterogeneal, divide the sum of the products by the sum of the errors, the quotient shall be the answer.

Arithmetical progression.

WHerein 5 things are considerable a = first term T = number of terms X = common difference ω = last term Z = sum of all the terms and T-1 = number of differences, as also T X-X will be = $\omega - a$ = sum of the differences, any 3 of the first 5 given the rest are found by the 20 propositions following, as our great *English* Mathematician Mr. *Oughtred* hath delivered them.

1 $T\omega + Ta = 2Z$

2 $\frac{\omega - a}{T - 1} = X$

3 $\frac{\omega - a}{X} + 1 = T$

4 $\frac{\omega q - aq}{x} + \omega + a = 2Z$

5 $\frac{2Z}{\omega + a} = T$

6 $\frac{\omega q - aq}{2Z - \omega - a} = x$

7 $Tx - x + 2A \text{ in } T = 2Z$
8 $Tx - x + a = \omega$

9 $\frac{2Z - 2aT}{Tq - T} = x$

10 $\frac{2Z - 2AT}{Tq - T} = X$

11 $\sqrt{v:} - \frac{x}{4} + 2Zx + aq - xa + \frac{x}{2} : - \frac{x}{2} = \omega$
if $B = 2a - x$

12 $\sqrt{v:} \frac{Bq}{4xq} + \frac{2Z}{x} : - \frac{B}{2x} = T$

13 $\omega + x - Tx = a$
14 $2\omega + x - Tx \text{ in } T = 2Z$

15 $\frac{2Z}{T} \omega = a$

16 $\frac{2\,\text{T}\omega - 2\,\text{Z}}{\text{X}} = \text{X}$

17 $\sqrt{\upsilon - \frac{\text{Xq}}{4} + \omega\text{q} + \text{X}\omega - 2\text{Z}\text{X}} + \frac{\text{X}}{2} = a$

18 $\frac{2\omega + \text{X}}{2\,\text{X}} - \sqrt{\upsilon \frac{44\omega\text{q} + 4\text{X}\omega + \text{Xq} - 2\text{Z}\text{qX}}{4\text{Xq}}} = \text{T}$

19 $\frac{2\text{Z}}{2\text{T}} + \frac{\text{TX}}{2} - \frac{\text{X}}{2} = a$

20 $\frac{2\text{Z}}{2\text{T}} + \frac{\text{TX}}{2} - \frac{\text{X}}{2} = \omega$

Geometrical Progreſſion.

A the firſt, β the ſecond term, ω the laſt, N the number of the terms, Z ſumme of the terms.

$a.\ \beta.\ \frac{\beta q}{a}\ \frac{\beta c}{aq}\ \frac{\beta qq}{a^{c}}\ \frac{\beta qc}{aqq}\ \frac{\beta cc}{aqc}$

$\frac{\beta qqc}{acc}\ \frac{\beta qcc}{aqqc}$ &c, are ∴

Becauſe α & $\frac{\beta q}{\alpha}$ each drawn into α it will be $\alpha \cdot \frac{\beta q}{\alpha}$ 3^d term :: $\alpha q \cdot \beta q$. again becauſe α & $\frac{\beta c}{\alpha q}$ draw each into αq, it will be $\alpha \cdot \frac{\beta c}{\alpha q} :: \alpha c$. ſo $\alpha \frac{\beta qq}{\alpha c} :: \alpha qq \cdot \beta qq$ and $\alpha \cdot \frac{\beta qc}{\alpha qq} :: \alpha qc \cdot \beta qc$ and $\alpha \frac{\beta cc}{\alpha qc}$ the 7th terme :: αcc βcc &c.

Betwixt α & β to find mean proportionalls, becauſe $\alpha \cdot \beta \cdot \frac{\beta q}{\alpha} \frac{\cdot\cdot}{\cdot\cdot}$ draw each into α, as αq $\beta\alpha$ βq for one, again becauſe $\alpha \cdot \beta \cdot \frac{\beta q}{\alpha} \cdot \frac{\beta c}{\alpha q} \frac{\cdot\cdot}{\cdot\cdot}$ draw each into αq, as αc, $\alpha q \beta \cdot \alpha \beta q \cdot \beta c \div$ for two, likewiſe $\alpha qq \cdot \alpha c \beta \cdot \alpha q \beta q \cdot \alpha \beta c \cdot \beta qq$ for three &c. according to the admirable Binomial Table, wherein all the intermediate ſpecies taken without the *uncia*, are mean proportionalls, or $\alpha \cdot \sqrt{qq}\ \alpha c \beta \cdot \sqrt{qq}\ \alpha q \beta q \cdot \sqrt{qq}\ \alpha \beta c \cdot \beta \div$. Becauſe $\alpha \cdot \beta :: Z - \omega$ the ſumme of all the *antecedents* to $Z - \alpha$ ſumme of all the *conſequents* hence.

$\beta\omega$

$$\frac{\beta\omega - \alpha q}{\beta - \alpha} :: \quad . \quad = Z$$

In Anatocisme let the Ratio be $1 = \alpha \cdot \beta ::$ then β will be the Ratio the severall *multiples* may be continued thus,

A . B . C . D . E . F . G : H . I

α β . βq . βc . βqq . βqc . βcc βqqc . βqcc. βccc

β in $N - 1 =$ continually multiplyed $= \beta qcc =$ ω, and β continually drawn into $N = \beta ccc = \beta\omega$. then if $\alpha = 1$:

$\beta ccc = \beta\omega :: A . I$ The first *Theorem.*

$\beta ccc : \alpha :: I . A$ Second *Theorem.*

because $\frac{\beta\omega - \alpha q}{\beta - \alpha} = \frac{\beta\omega - 1}{\beta - 1} = Z$ if

$\alpha : \frac{\beta\omega - \alpha}{\beta - \alpha} :: P =$ Pensions intermit } Third *Theorem.*

or because $R . S :: \frac{R}{S} \; 1$. expresse it

$\beta - 1 \quad \beta\omega - 1 :: P . Z$ the summe of the Pensions.

$\beta\omega - 1 . \beta - 1 :: Z . P$ Fourth *Theorem.*

because $\beta\omega . 1 :: \frac{\beta\omega - 1}{\beta - 1} \cdot \frac{\beta\omega - 1}{\beta - 1}$ in $\beta\omega$ say:

$\beta-1$ in $\beta\omega$: $\beta\omega-1$ :: so the Annuity to continue any number of times = Y to the present worth . Q } Fifth *Theorem.*

$\beta\omega-1$. $\beta-1$ in $\beta\omega$ :: Q . Y . Sixth *Theorem.*

Aequation.

TO distinguish the *data* and the *quaesita*, for those let consonants for these vowells: Imagining that done that is required, by an *Analytical* method working according to the nature of the question till some equality, *viz. via eandem quantitatem duobus modis exprimendi* (as the most acute *Des Cartes* saith) be found; then reducing things known to one side of the *Aequation*, the unknown (*quatenus fieri possit*) either by *Antithesis* which transfers *data & quaesita* to each other side under a contrary sign, SA + SB = RC − RA will bee SA + RA = RC − SB or *Isomeria*, where any of the sought quantity is in a fraction as $E+D=\frac{Eq-Bq}{C}+K+R$ must be EC + DC = Eq − Bq + KC + RC . or *Paraboliſmus*, when the higheſt *ſpecies* ſought is drawn into any given; then let there be *adplication* of all the *ſpecies*, to that known *ſpecies* Mc = DEq + DqE thus $\frac{Mc}{D}=Eq+DE$ or *Hypobibaſ-*

mus,

mus, when all the given *ſpecies* are drawn into ſome degree of the ſought, then depreſſion muſt be made by adplication of them to the loweſt *ſpecies*, Bq Eq = Eqq + CEc will be Eq + CE = Bq . or if any *ſpecies* be expreſſed by a ſurd ſide, raiſe the *Aequation* to the powers themſelves, if √q DA = R − S then DA = Rq − 2RS + Sq.

When this ſeparation of certain from uncertain is finiſht, by which the *Aequation* is brought to the ſimpleſt termes it can be: that uncertain quantity will be either a ſide or ſome Superior *Poteſtas, pure*; the *Logiſtical* ſolution of both which kinds is manifeſt: But if the *Poteſtas* be adfected, the inveſtigation of the Root will require much attention and labor ſometimes: the *Analyſis* whereof will be underſtood as ſoon as the *Geneſis* is explicated, as before in the pure or unadfected let them be ſuch as theſe Aq + BA = + Cq or Ac + BAq = Dc or Ac + CqA = Dc. or Aqc + BAqq = Gqc. or Ac − BAq = Dc. or BA − Aq = Cq ſince ſuch are ſeldome otherwiſe then Binomial in relation to the notes of numbers in ſtead of Aq + BA = Cq imagine A = L the eductitious ſide, as before, or A + E it may be Q : A + E : pl: A + E into B = Cq : that is Aq + 2AE + Eq + BA + BE = Cq accordingly the reſt may be deſigned as in the Table.

Diagonal.

Diagonal.	Gnomons.					
Aq	2AE	Eq	} = Cq			
BA	BE					
Ac	3AqE	3AEq	Ec	} = Dc		
BAq	B2AE	BEq				
CqA	CqE					
Aqq	4AcE	6AqEq	4AEc	Eqq	} Fqq	
BAc	B3AqE	B3AEq	BEc			
CqAq	Cq2AE	CqEq				
DcA	DcE					
Aqc	5AqqE	10AcEq	10AqEc	5AEqq	Eqc	} Gqc
BAqq	B4AcE	B6AqEq	B4AEc	BEqq		
CqAc	Cq3AqE	Cq3AEq	CqEc			
DcAq	Dc2AE	DcEq				
FqqA	FqqE					

88

let 648 q + 18 L
=431568

Aq × BA=Cq

18 coef:

the geniture whereof in numbers is thus, not much different, but for the taking in of the coefficients, from the pure powers By this table the compoſure of more adfected æquations may be ſet down. let now Lq+18L =431568

6	.	4	.	8	L
36	Aq				
1	0	8		BA	
4	8		2	AE	
	1	6		Eq	BE gnomon
		7	2		
42	1	1	2		=Aq+BA
1	0	2	4		2 AE
			6	4	Eq gnomon
		1	4	4	BE mō
43	1	5	6	8	

that is Lq be not pure but adfected under L and given long: 18 namely to know what number drawn into it ſelf and 18 is equal to 431568 or Lc+30L=14356197 namely a number drawn into its ſquare and 30 the analyſis of the former thus, and other cubically adfected may be reſolved.

A more expeditious method is set down by that excellent analyst Mr. *Oughtred*, when the species equally ascend by supposing the absolute number given a reactangle Æ made up of A, E sought or A q, Eq *viz.* such as the *potestas* of the middle species. And (if in the middle species the highest be negative) the coefficient = B is the sum = Z and expounded of both A, E. but if adfirmative, the coefficient the difference =X=A-E, if negative expounded of A, if adfirmative of E.

1 8 coef:		
4 3 1 5 6 8		(648
3 6 | | A q		
1 0 8 B A		
6 0 7 6 8		
1 2 | |	2 A B	divisor.
| | 1 8		
4 8 | |	2 A E Eq BE	gnomon.
| 1 6 | |		
| | 7 2		
5 0 3 2		gnomon.
1 0 4 4 8		
| 1 2 8 |	2 A B	divisor.
| | | 1 8		
1 0 2 4	2 AE Eq BE	
| | 6 4		
| 1 4 4		
1 0 4 4 8		gnomon.

1. Rule $\frac{Z}{2} \pm \sqrt{v : \frac{Zq}{4} - Æ} : = \begin{matrix} A \\ E \end{matrix}$

2. Rule $\sqrt{v : \frac{Xq}{4} \mp Æ} : - \frac{X}{2} = \begin{matrix} E \\ A \end{matrix}$

A Table of B drawn into N when the payment is yeerly according to 6 in the 100 uſefull and the logarithmes (the uſe whereof in thoſe queſtions of Anatociſme is ſtupendious) are not *in promptu*, with ſeveral Ratio's uſeful in practice.

1. Like Planes in duplicated *ratio* or as the ſquares of their homologal ſides *viz.* 272|15 (Q16, ſtatute pole) to 324 (Q18 the woodland pole) ſo *viz.* 26 acres ſtatute meaſure to woodland meaſure.

2. Like ſolids in triplicated *ratio*, or as the cubes of homologal ſides, *viz.* if 18 *pound* ½ of powder will charge a Cannon whoſe diameter in the concave cylinder is |583333 of a foot: how much will charge a demicannon whoſe concave diameter is |353666 of an inch, as |340277388 =

1	1|06
2	1|12236
3	1|191016
4	1|26247696
5	1|33822557
6	1|418519112
7	1|50363025
8	1|59384807
9	1|6894789
10	1|7908476
11	1|89829855
12	2|01219646
13	2|13292825
14	2|26090394
15	2|39655817
16	2|53014169
17	2|68195019
18	2|84286723
19	3|1343923
20	3|19424534

889

889 (Q 583333) is to 1256796 39556 (Q 353666) :: ſo the charge 18 15 to 6 by the Reciprocal Rule you may find the charge of powder that is ſtronger or weaker.

3. Ratio of the Diam. to the Periph. 1 to 3 14159265 :: or 3183098 to 1 :: as 1 3 14159 :: ſo the Q: Rad. Area. as 1 . 07957 :: Q: Periph. Area.

4. In a Cone 1 . 3 14159 :: Diam. * Axis : Superf. and as 1 . 7854 :: Dq * $\frac{\text{Axis}}{3}$: Solidity.

5. In a Cylinder as 1 . 3 141519 :: Diam. * Axis : Superfic. as 1 : 7854 :: Dq * L : Solid.

6. In a Sphære . 1 . 3 14159 :: Dq : Superf. and as 1 : 5236 :: Dc . Solid.

7. Divide 1 by the breadth gives the length for a plain foot: but by the baſe gives the length for a ſolid foot to be taken in the perpendicular height.

8. In perfect Cone or Pyramis Bas * $\frac{\text{Alt}}{3}$ = Solid.

9. In a decurted √q : Baſmai : * baſmi : pl. baſmai

basmai + basmi, duct in $\frac{\text{Alt}}{3}$ = Solid.

10. In gaugeing $\frac{2}{3}$ max. cicli + $\frac{\text{min. cicli}}{3}$ duct in long = capacity. say

1 | 5236 / 2618 :: ○ Diam: $\frac{2}{3}$ / $\frac{1}{3}$

Because by experience the Cubic foot containes nigh 7 gallons and $\frac{1}{2}$ of wine according to which the wine gallon = 1336803 the beer gallon = 1575521.

FINIS.
